Airworthiness Assurance
Center of Excellence

April 11, 2003
FAA William J. Hughes Technical Center
Atlantic City International Airport, NJ

Xiaogong Lee, Ph.D.
AACE Program Manager

AACE Vision

Federal Aviation Administration
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Airworthiness Assurance Center of Excellence

The Airworthiness Assurance Center of Excellence will strive for *technical excellence* through partnership to provide the FAA with *outstanding technology resources* by combining the best of government, academia, and industry to make the safest even safer.

AACE MISSION

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Make significant contributions to the FAA mission of fostering *a safe and efficient air transportation system* through innovative partnership of the leading talent in government, academia, and industry

AACE ROLE:

- Develop and maintain technology partnership
- Promote and conduct research to improve aviation safety
- Facilitate technology transfer and implementation
- Develop education and training tools for aviation safety
- Provide an opportunity for students to participate in industrially relevant research

AACE

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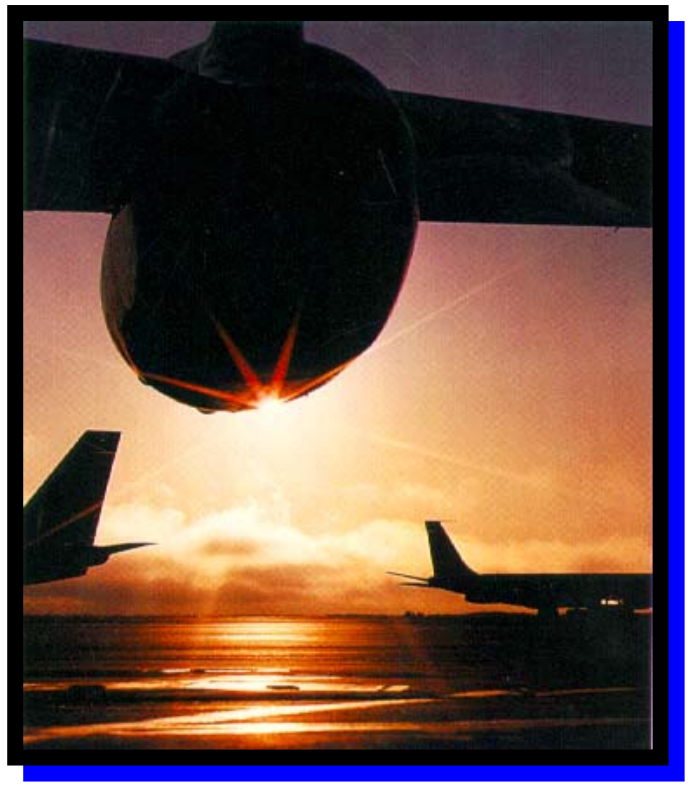
- Established in September 1997
  - A technical partnership of Government, academia, and industry
  - A hybrid procurement process (grants & contracts)
  - Currently 28 universities & FAA-AANC



- Completed first 3-year (Phase I) in Nov. 2000
- Initiated second 3-year (Phase II) in Dec. 2000

AACE Members

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28 Member Universities

- Arizona State University
- Baylor University
- Carnegie Mellon
- Embry-Riddle
- Iowa State University
- John Hopkins
- Lehigh University
- Mississippi State
- North Carolina A&T State
- Northwestern University
- NJ Institute of Technology
- The Ohio State University
- Ohio University
- Pennsylvania State University
- Purdue University
- Rutgers University
- Tuskegee University
- University of Arizona
- UC-Berkeley
- UC-Los Angeles
- UC-Santa Barbara
- University of Dayton
- University of Maryland
- University of Missouri
- University of North Dakota
- University of Utah
- Wayne State University
- Wichita State University

- **AANC – FAA Airworthiness Assurance NDI-Validation Center**

AACE Members

Geographic locations

Federal Aviation Administration

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AACE Program

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- Issued 106 Agreements/Contracts/Delivery Orders including 367 amendments/revisions for 151 research tasks
  - 31 Cooperative Agreements (3 Phase I & 28 Phase II)
    - 71 tasks under 128 amendments
  - 22 Contracts
    - 22 tasks under 46 amendments
  - 1 IA (Sandia National Laboratories)
    - 4 task areas (over 20 tasks) under 27 amendments
  - 52 ISU Delivery Orders
    - 52 tasks under 166 Amendments
- Total funding: >$60M through FY-03

AACE Funding

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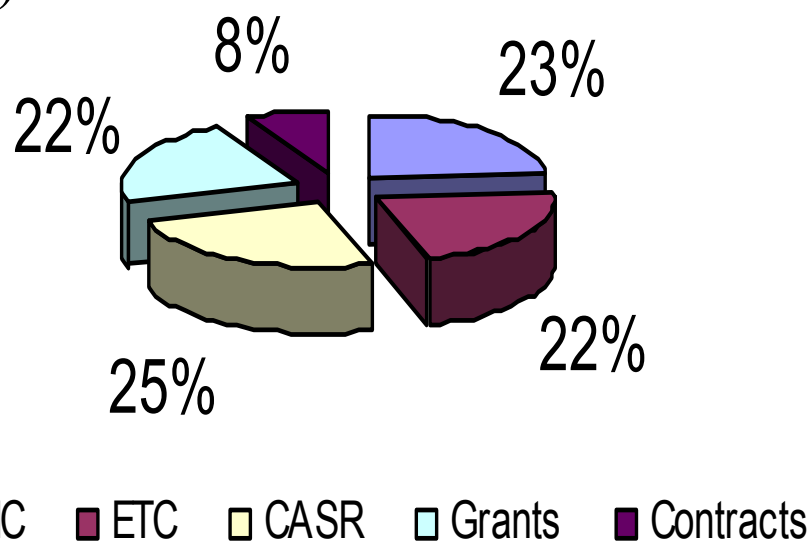
- Total funding: > $60M
  - IA/Contracts
    - AANC (IA/ISU DO) >$14M (23%)
    - ETC (ISU DO) >$13M (22%)
    - CASR (ISU DO) >$15M (25%)
    - Contracts* >$5M (8%)
  - Grants
    - >$13M (22%)



* - Contracts directly to AACE members excluding ISU

Phase I Research

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- Phase I (09/1997 – 11/2000) (ISU/OSU)
  - Worked with 14 universities with over 50 industry partners
  - Completed 42 research tasks in 5 technical disciplines
  - Provided a total of $17.6 Million funding
  - Received $7 million University/industry cash match and in-kind support
  - Supported nearly 100 students
  - Generated over 150 publications and 19 theses

Phase I Research

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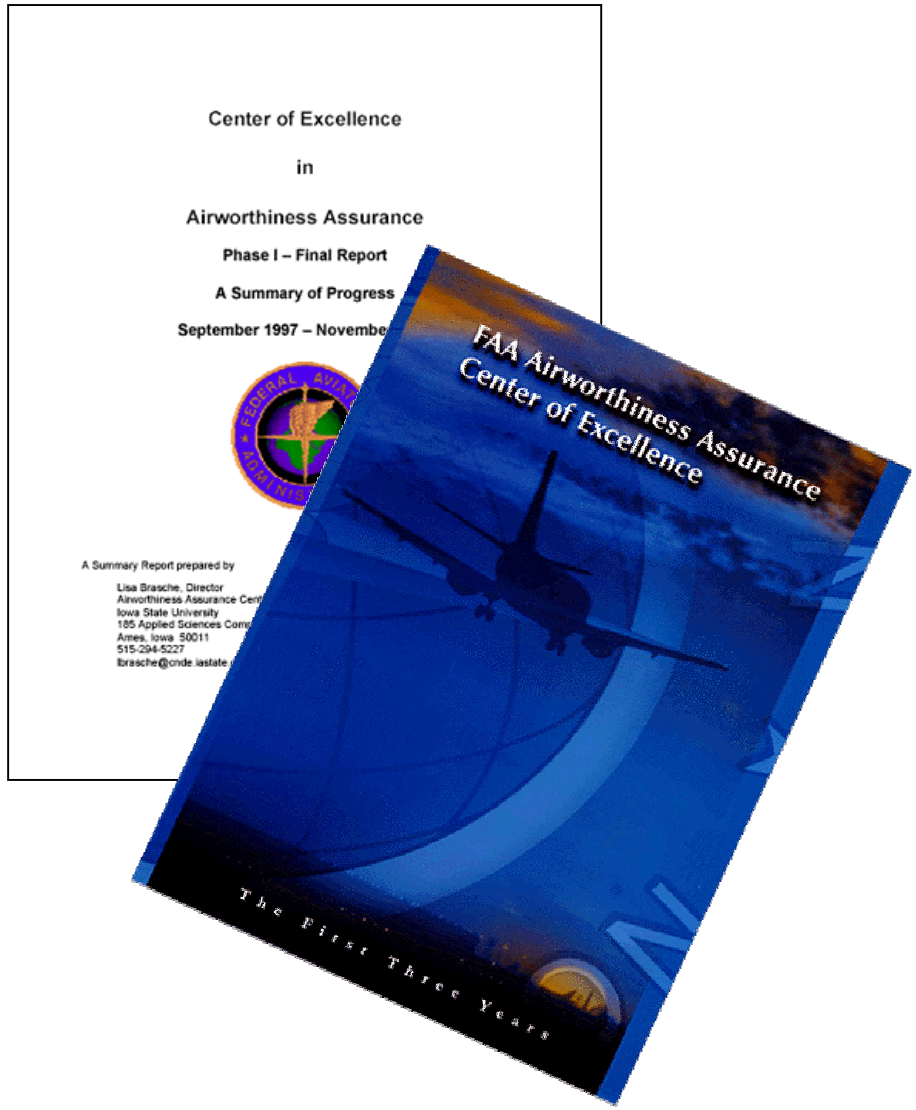
- Phase I report
- Generated Patents, Licensing and Commercialization
  - Patents on Computer Aided Tap Test (ISU)
  - Commercialization of the Computer Aided Tap Test - licensed to Advanced Structural Imaging, Inc.
  - Commercialization of XRSIM - licensed to NDE Technologies, Inc.
  - Pre-licensing trial of the signal processing software to ANDEC
- Completed Field and Beta tests of various NDI techniques



Phase II Research

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- Phase II (12/2000 –11/2003)
  - Consists of 28 university members and AANC
  - Directly administered/managed by the FAA
    - Separate cooperative agreement for each member
    - Individual grants and contracts to member universities
  - Conducted 110 research tasks to date
    - In 9 different technical disciplines
    - Supports 102+ faculty members and research engineers
    - Students: 100 undergrad, 92 grad MS, 44 grad Ph.D., and 22 post-docs (241 + students)
    - Completed Degrees: 38 BS, 32 MS, and 10 Ph.D. (80 + Total)
  - Completed 119+ technical publications and 55 + FAA technical reports

Phase II Research

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- Procurement Procedures
  - Allows Grants and Contracts directly to AACE members
  - Utilizes existing ISU Contract for CASR and ETC tasks
  - Grants under Cooperative Agreement with individual members
    - Limited competition for AACE member universities only
  - Contracts
    - Broad Agency Announcements (BAA)
    - Open Competition within AACE Member Universities
    - Sole-source contracts

AACE Research Areas

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- Advanced Materials
- Atmospheric Hazards
- Aviation Safety Risk Analysis
- Catastrophic Failure Prevention
- Crashworthiness
- Inspection, Maintenance, and Repair
- Propulsion and Fuels
- Software and Digital System Safety
- Structural Integrity and Flight Loads
- Validation and Technology Transfer

Advanced Material

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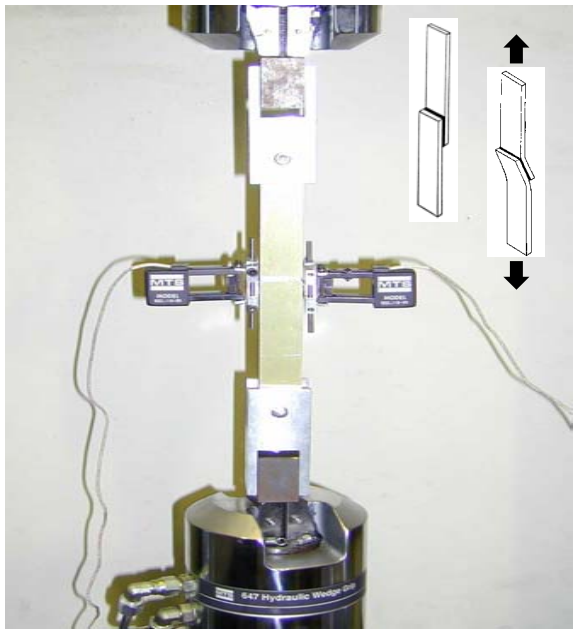
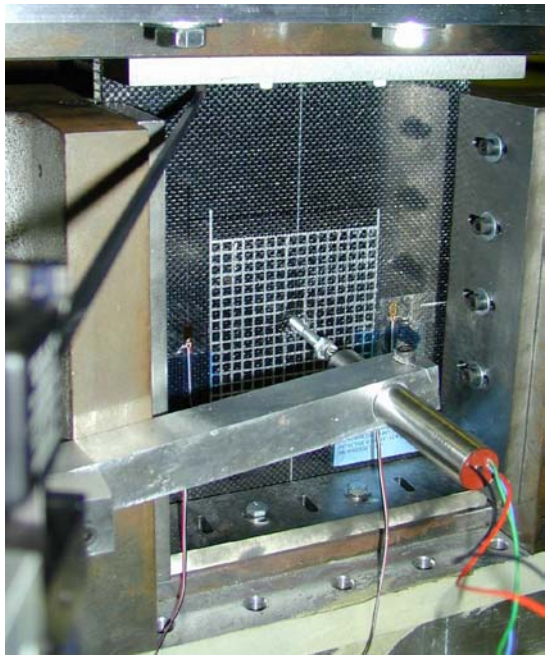
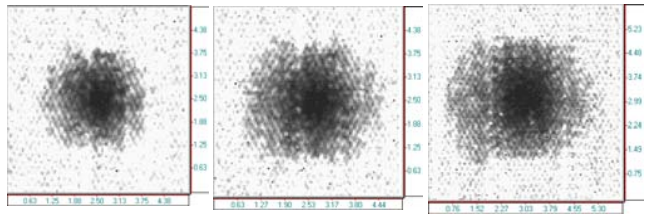
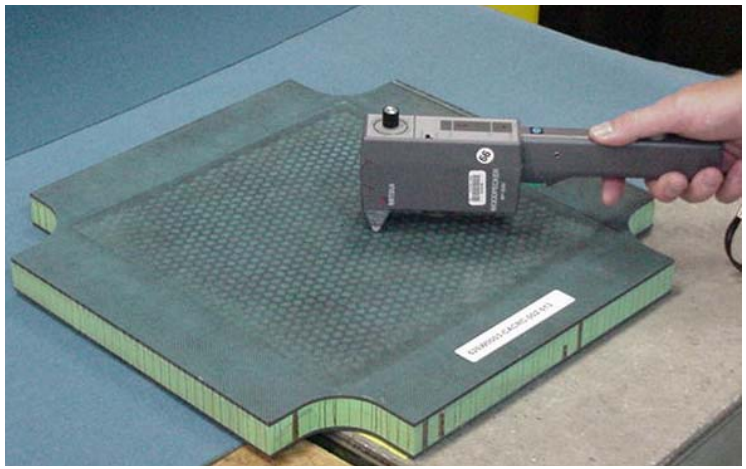
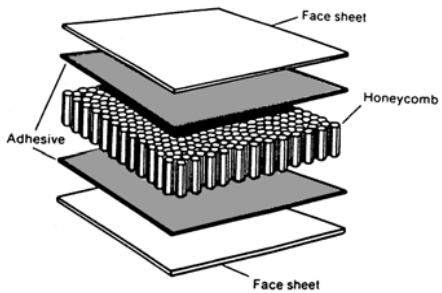


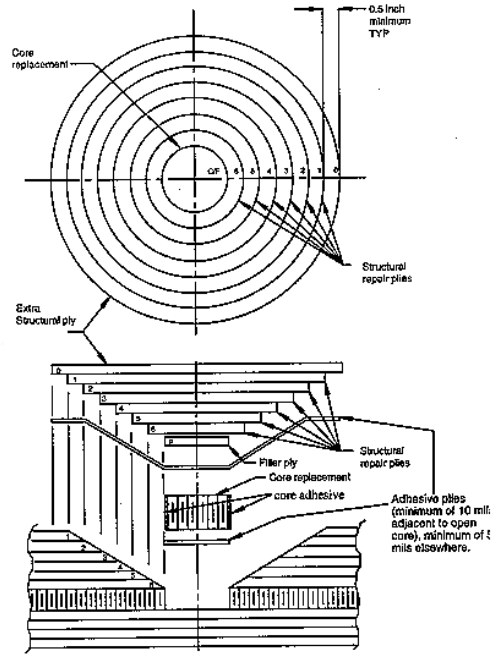


COMPOSITE RESEARCH









REPAIR OF SANDWICH PANEL – TAPER SANDING METHOD

In-Flight Icing Research

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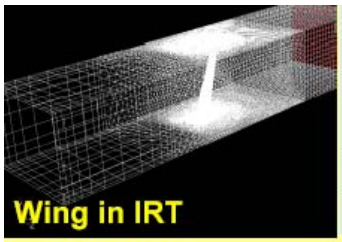
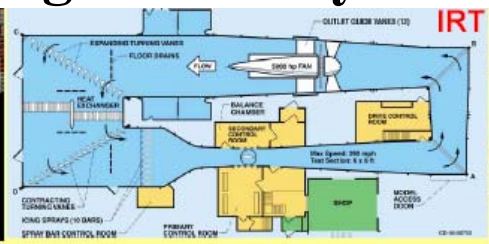
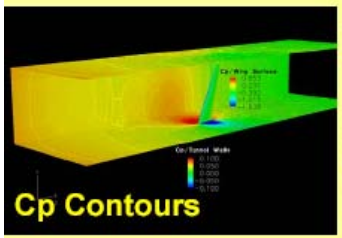
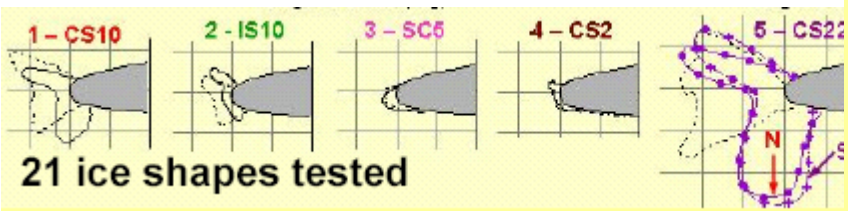
Critical Ice Shapes on Finite Wing Geometry



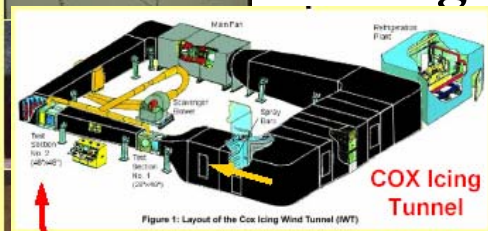


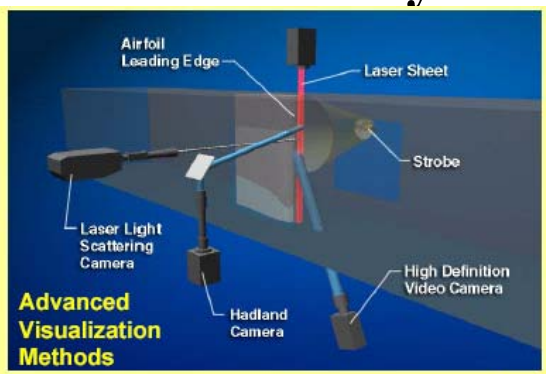


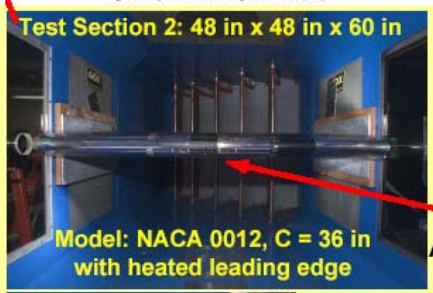


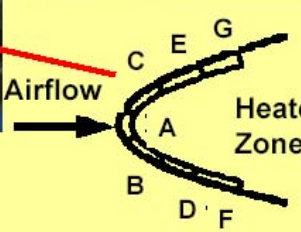
- Joint FAA, NASA, and Industry Efforts

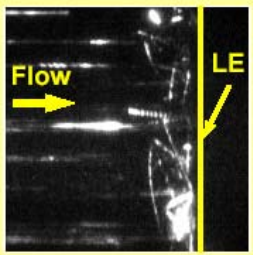
Effects of Mixed Phase Icing Condition Study











Snow nozzle developed by COX for mixed phase icing cloud simulation

Ice and water particle impingement dynamics

Catastrophic Failure Prevention

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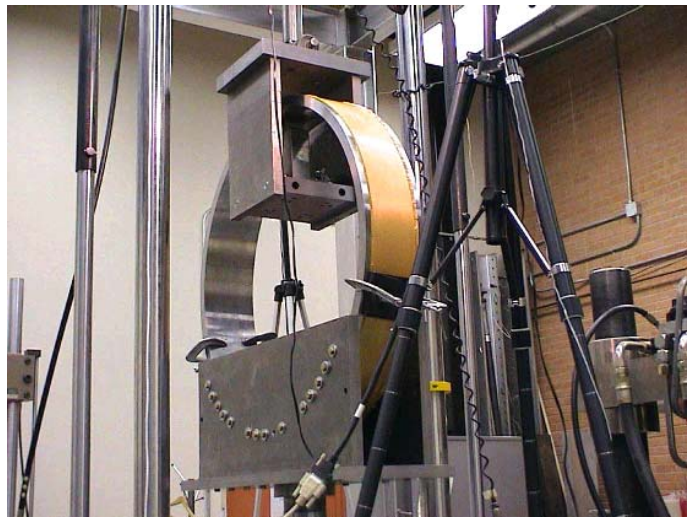
- Active industry participation
  - ASU teamed with Honeywell, SRI, and NASA with Honeywell providing cost matching
  - UCB teamed with Boeing, and SRI
  - UCB teamed with Boeing and Lawrence Livermore National Laboratories



- Shared resources
  - Boeing and Honeywell provide **100% cost matching**

- Technical collaboration, data sharing, and immediate technology transfer to industry
- Potential applications to aviation security

Catastrophic Failure Prevention

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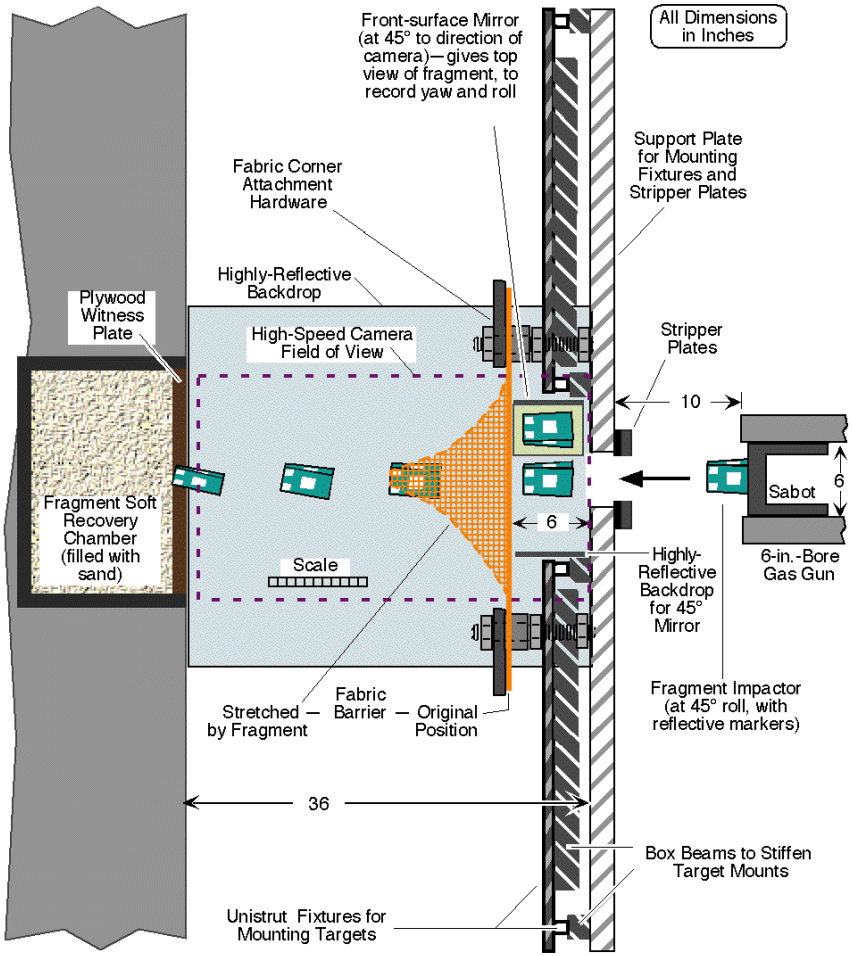
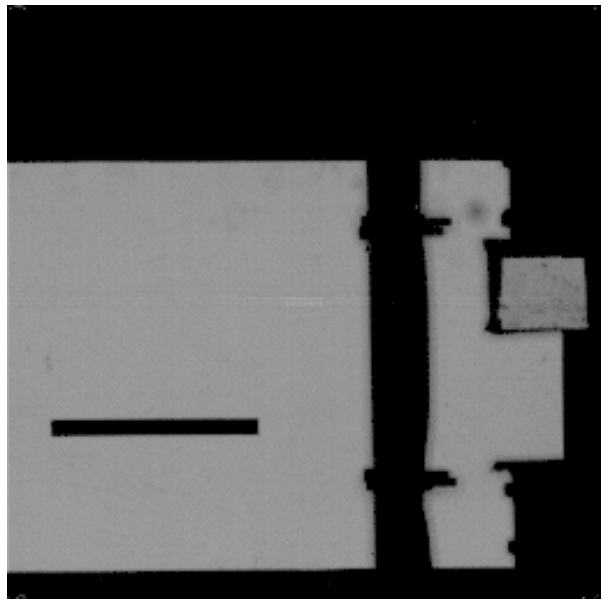
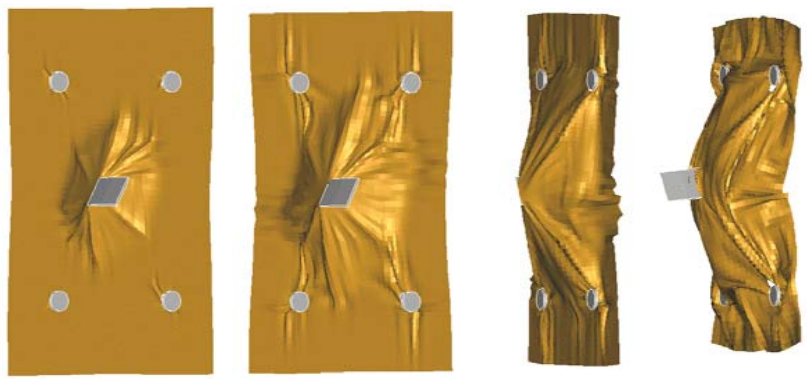
- Zylon large-scale penetration tests and numerical simulations







(a) 0.5 ms (b) 0.8 ms (c) 1.2 ms (d) 2.4 ms

Crashworthiness

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- Validation of NIAR Head Injury Criteria Tester for Part 23 and 25 Applications
  - A joint effort of NIAR and FAA CAMI
  - Industry involvement (SAE Seat Committee)

- Seat Cushion Replacement Program
  - Classification of various seat cushion foams
  - Validation of AGATE procedures
  - Full-scale dynamic seat tests

- Side Facing Seat Research
  - Performance Standards and Certification Requirements

Maintenance, Inspection, and Repair

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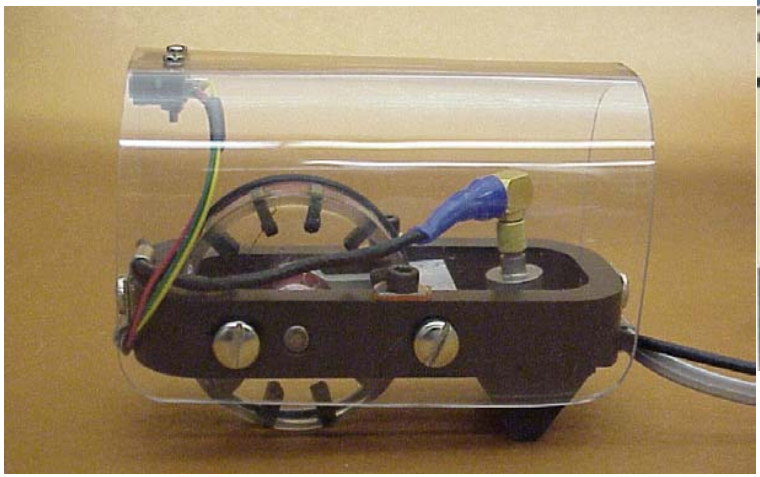
- Three Major Program Areas
  - Center for Aviation System Reliability (CASR) – ISU
  - FAA Airworthiness Assurance NDI-Validation Center (AANC) – Sandia National Laboratories
  - Engine Titanium Consortium (ETC)



Maintenance, Inspection, and Repair

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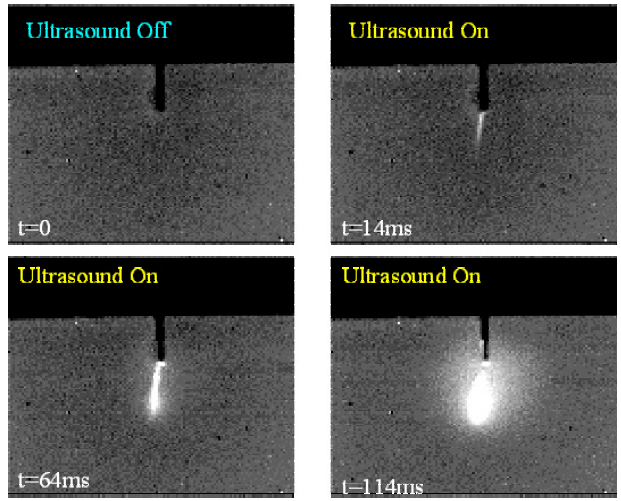
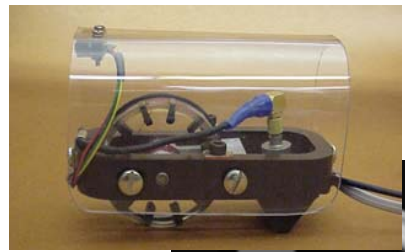
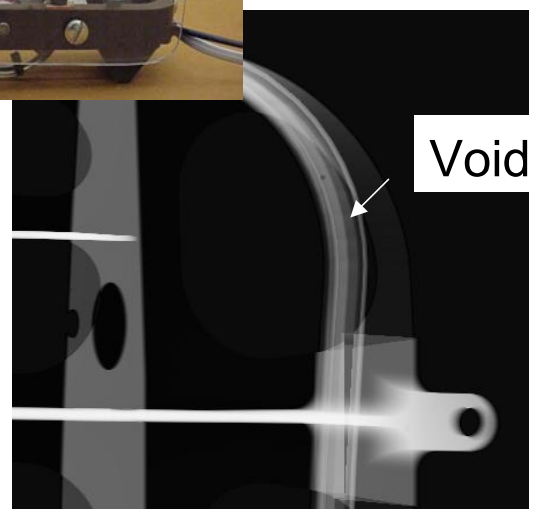
- NDI Accomplishments Highlights
  - Technology development
    - Completed prototype of Thermosonics
    - Completed prototype of Pulse Eddy Current for Aviation
    - Developed NDI Guidance Material for FAA
    - Developed NDI methods for composite repairs
  - Patents and Licenses
    - Computer Aided Tap Test - 2 patents
    - XRSIM (computer software) – licensed
  - Commercialization
    - Computer Aided Tap Tester
    - Commercial version of x-ray simulation tool







Maintenance, Inspection, and Repair

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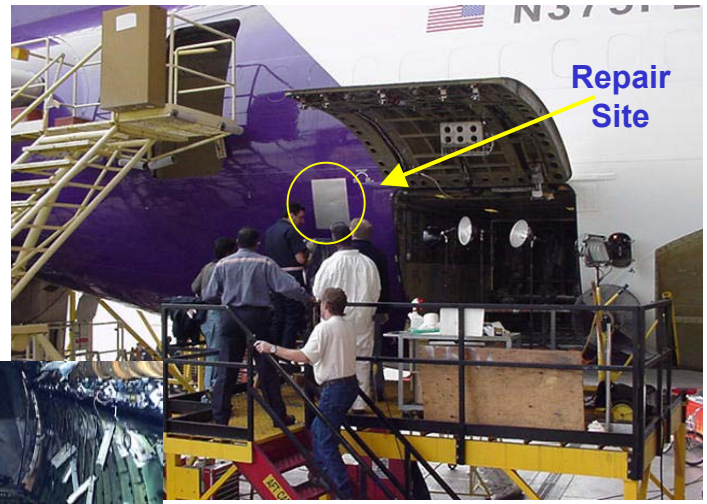

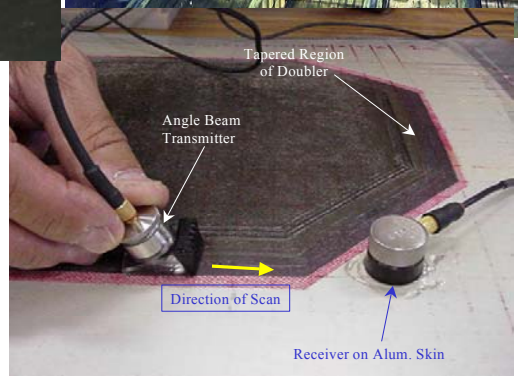

Maintenance, Inspection, and Repair

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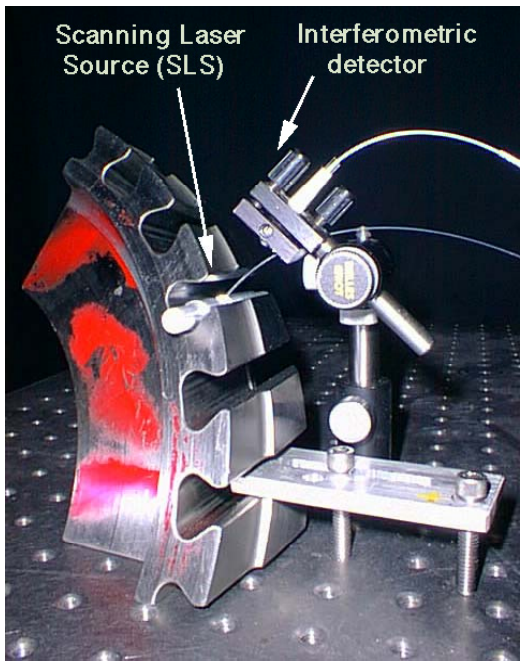
Iowa State University
Pratt & Whitney
ETC
Honeywell
General Electric



- ETC Program Highlights
  - To provide reliable and cost-effect tools for detecting cracks, inclusions, and imperfections in critical rotating engine parts
  - 7 research tasks on-going
  - 1 research task completed
  - Began first production inspection of Nickel billet using the developed multizone system
  - Completed Fluorescent Penetrant Inspection Final Report

Propulsion and Fuels

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- Ethanol as aviation fuel
  - Investigate the use of avgas and ethanol as means of transitioning from avgas to ethanol in the least disruptive manner, i.e. aircraft certified to use all blends of avgas and ethanol could continue to fly without interruption during the change over from 100LL to E-95.
  - **Contract matched 100%**

Software and Digital System Safety (SDSS)

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- New technical area started in Phase II
  - Focus on identifying and addressing digital technology and safety issues in software, complex electronic hardware, and digital systems
  - Support the FAA policy and guidance initiatives
  - 5 on-going research tasks
    - COTS Ground Systems Verification
    - Ethernet as an Aviation Databus
    - Adaptive Flight Controls for General Aviation
    - Real Time Scheduling Analysis
    - Software Development Tools Assessment

Structural Integrity

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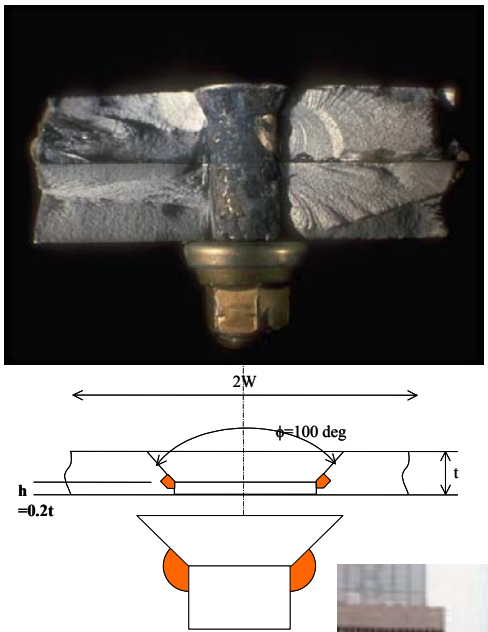
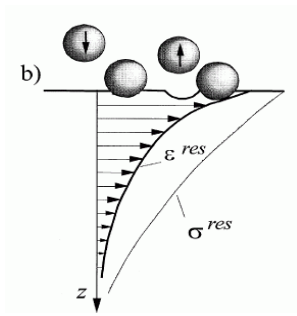
Crack Growth Analysis



Aging Airplane Lab for Small Airplane at NIAR

DTA Application to Rotorcraft



b) Plastic stretching

Properties of Shot-Peened Materials

Exploring New Technology Areas

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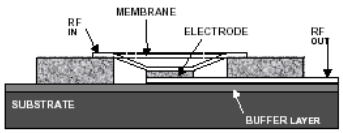
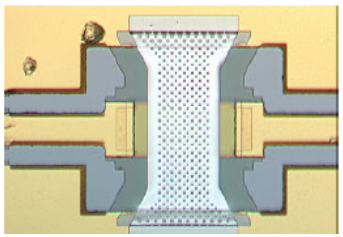
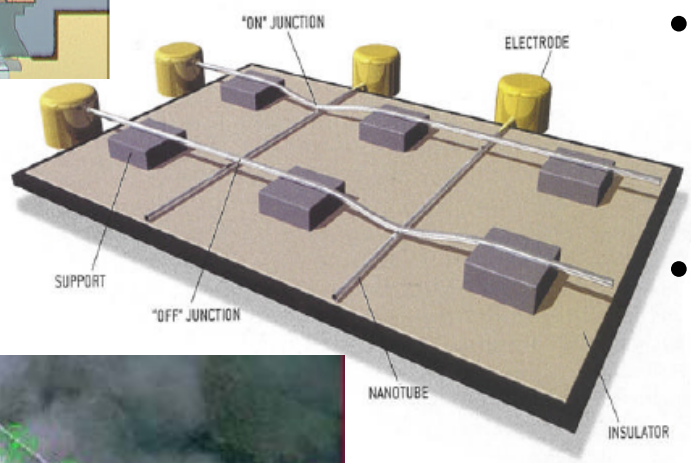
MEMS Switch





Carbon Nanotube NEMS Switch



- Research on Nanotechnology
  - Identify potential applications to aviation safety
    - Relevant Applications of Nanotechnology to Aviation Safety
    - An Investigation of RF-MEMS Switches: Reliability and Material Issues
    - Integrated Micro-Optical Sensors for Condition Monitoring

Summary

Federal Aviation Administration
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Airworthiness Assurance Center of Excellence

- AACE represents a true partnership of Government, Academia, and Industry
- AACE provides the FAA with the best technology resources available in aviation safety research
- AACE makes significant contributions to the FAA mission in Aviation Safety
- AACE can deliver.

FAA
CENTERS OF EXCELLENCE

Resources to advance the technological future of the nation's aviation community

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